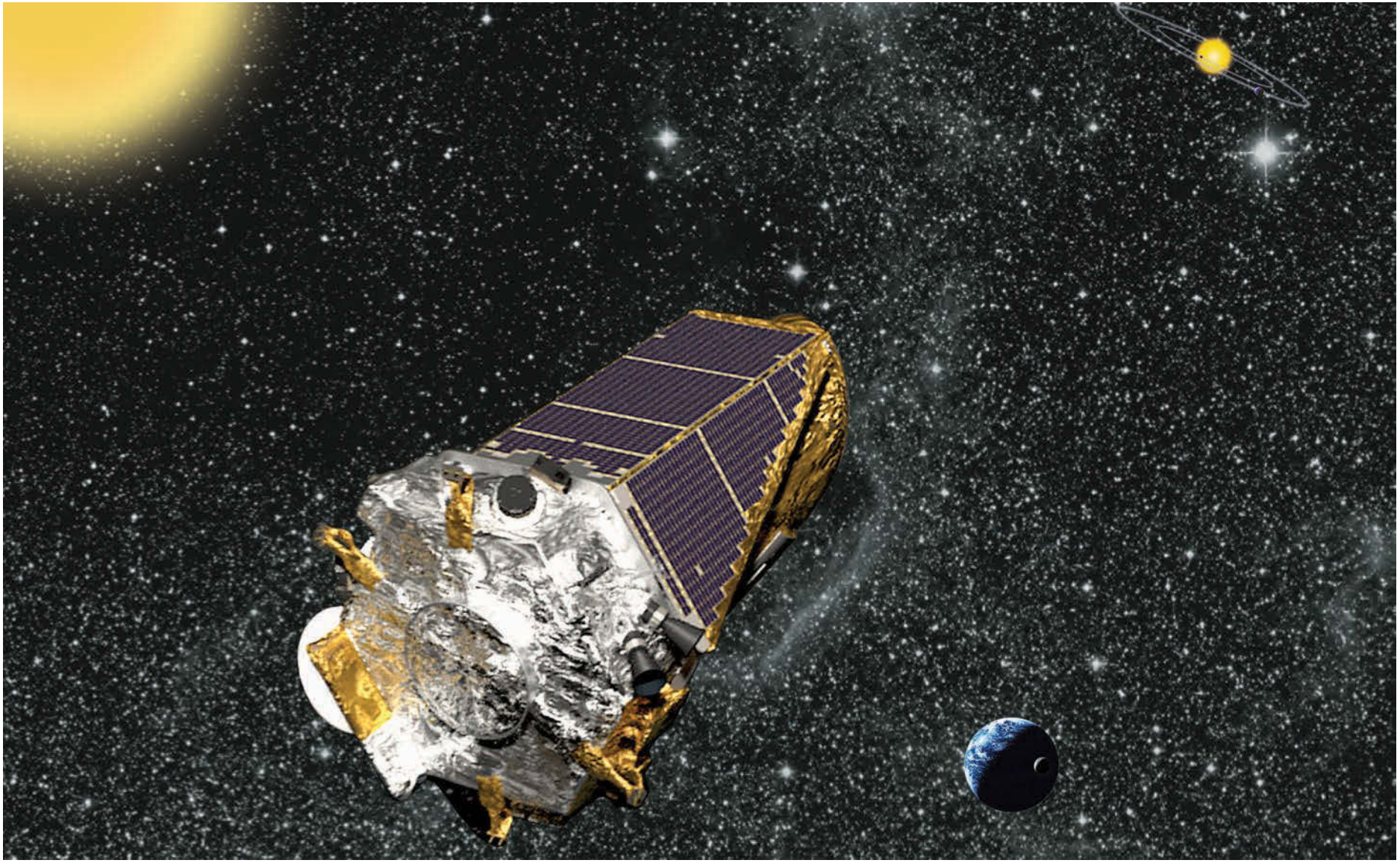
National Aeronautics and Space Administration



NASA Ames Research Center/W. Stenzel (OSC)/Artist's Concept

Kepler Mission: A Search for Habitable Planets

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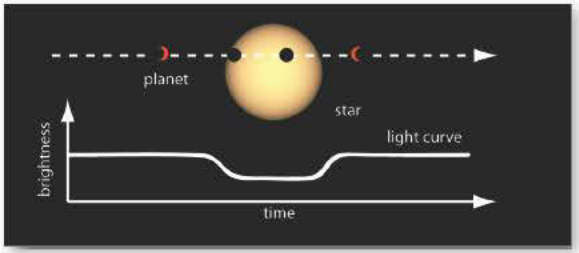
Are There Habitable Planets Beyond Our Solar System?

Is our Earth, which teams with life, unique in the universe? If not, how many Earth-size planets exist? How many could host life? NASA's *Kepler Mission* seeks to answer these age old questions by using the "transit method" for detecting planets. Launched March 6, 2009, *Kepler* is searching for Earth-size planets that orbit in the habitable zones of Sun-like stars. The habitable zone is the range of distances from a star where liquid water could exist on the surface of a planet, thus making life as we know it possible. For the first time in history, humans will know if there are Earth-size planets capable of supporting life beyond our solar system.

What Is The Transit Method?

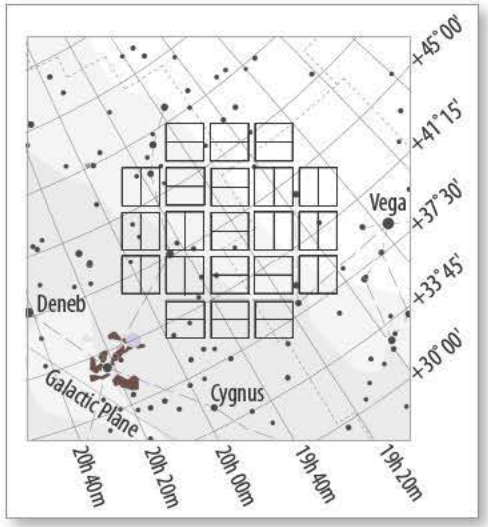
When a planet passes in front of a star as viewed from Earth, the event is called a "transit." On Earth, we can observe an occasional Venus or Mercury transit. These events are seen as a small black dot creeping across the Sun—Venus and Mercury block sunlight when they move between the Sun and us. *Kepler* finds a planet by looking for the tiny dip in brightness of a star when a planet transits in front of it. But the dips in brightness for Earth-size planets are extremely small. Detecting transits is like seeing the light dim when a gnat flies across a car's headlight as seen from many miles away.



Kepler*'s transit photometry measures the brightness variations of stars to detect Earth-size planets.*

How Does *Kepler* Do It?

The *Kepler* spacecraft is a specialized telescope that performs like a very precise light meter; it is called a photometer. *Kepler* stares at one area of the sky in the constellation Cygnus, an area larger than a hand held at arm's length (see illustration below).



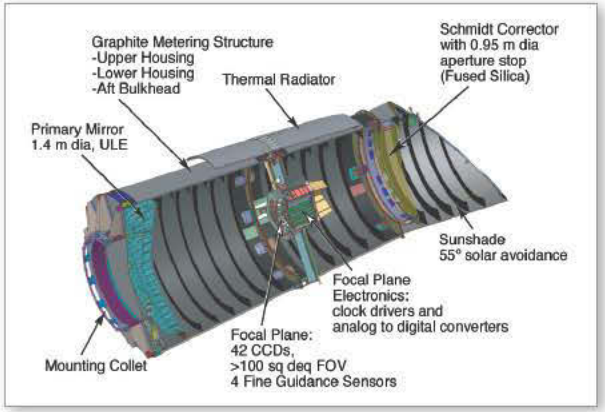
Kepler *Field of View with detector array shown*

Kepler is designed to stare continuously at this star field for years—essentially never blinking so as not to miss a transit—making brightness measurements of more than 100,000 stars every 30 minutes. By precisely measuring changes in each star's brightness and with some follow-up ground-based observations, the *Kepler Mission* determines the:

- types of stars that have planets
- sizes of planets
- duration of the planets' orbital periods
- distance planets are from their host stars
- characteristic temperatures of planets
- shapes of planetary orbits
- masses and densities of planets.

From Pixels to Planets

Going from starlight focused onto individual pixels to real planet discoveries is a long and complex process. Data for each star are recorded on the spacecraft and radioed to the ground once per month. The raw data are processed to produce light curves (graphs of brightness vs. time) for each star. The light curves are computer analyzed to search for sequences of transits. A team of scientists examines the results to decide which qualify as planetary candidates. Next, an extensive series of follow-up observations from ground-based observatories are performed on the many hundreds of candidates to eliminate false-positive cases, while improving our knowledge of the parent stars. Extensive analysis and modeling are performed on the original *Kepler* data and the newly acquired ground-based data to determine the true nature of each planetary candidate. About one-half of the candidates are rejected. Of the candidates that remain, those that meet all the discovery criteria are published in peer-reviewed publications. The others may simply require more *Kepler* observational data, or may be left as undecided planetary candidates for future research.



Photometer Cross Section

Mission Length

Kepler launched on March 6, 2009. The original mission lasted for three and one-half years until November, 2012. The original mission enabled the detection of 3 to 4 transits for each planet in the habitable zone of a star. The quality of *Kepler*'s data and the scientific information acquired has revolutionized our understanding of exoplanets and their stars. In 2012, NASA approved 4-year extension to the *Kepler Mission* until 2016 which will significantly further the primary goal of understanding the frequency of Earth-size planets in the habitable zones of Sun-like stars. *Kepler*'s discoveries will tell us if Earth-size planets are common orbiting around other Sun-like stars, or if they are rare.

Do You Want to Learn More?

On the *Kepler* web site, you will find news, computer animations, lessons, graphics, movies, detailed information about the *Kepler* team, and more.

Please visit **http://kepler.nasa.gov** and **www.nasa.gov/kepler**